inhalation therapy

Volume 6 Number 1 February 1961

IN THIS ISSUE

JOURNAL OF THE AMERICAN ASSOCIATION OF INHALATION THERAPISTS

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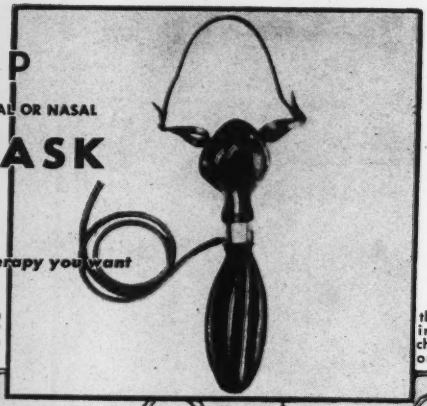
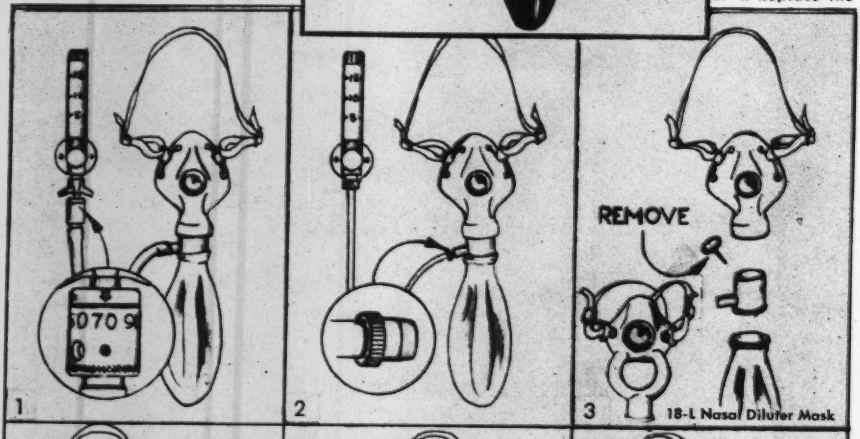
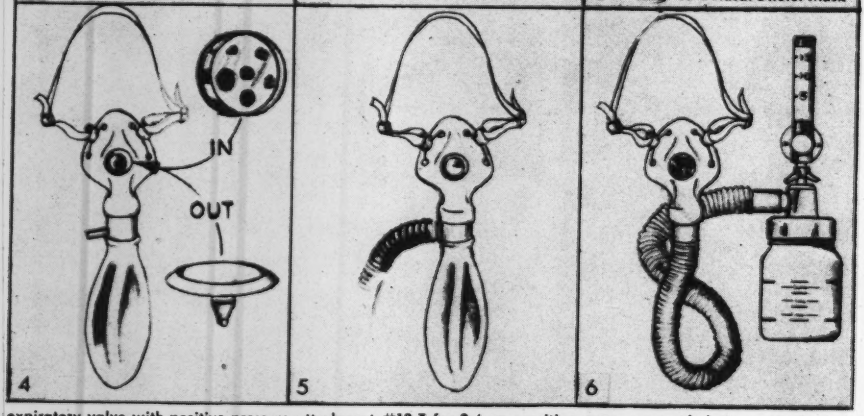


1: Set Oxygen concentration on Without diluter use as demand air rebreathing . . . or 3: Remove as partial rebreathing mask . . . the diluter . . . or 2: intake mask w/o check valve and use or 4: Replace the





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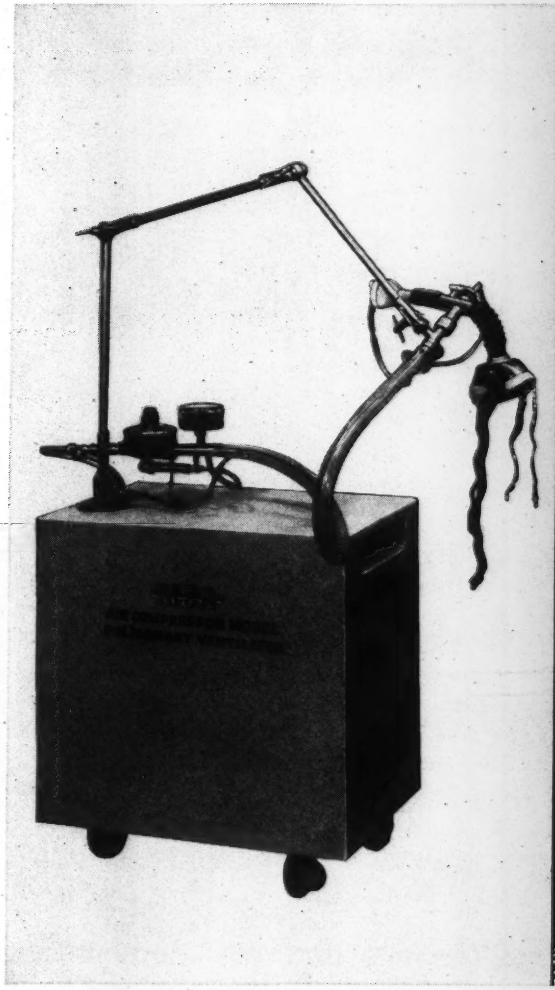

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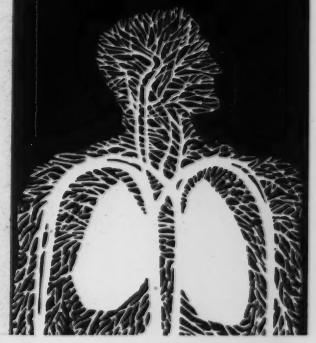

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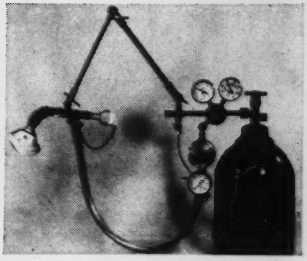

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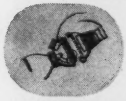

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VOLUME 6 NUMBER 1

inhalation therapy

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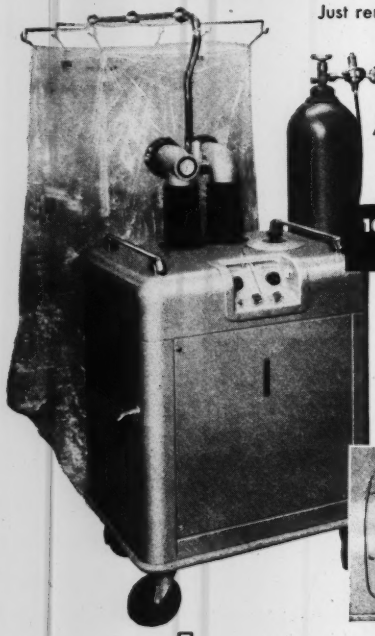

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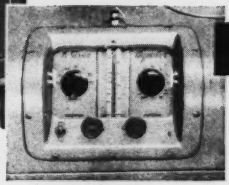

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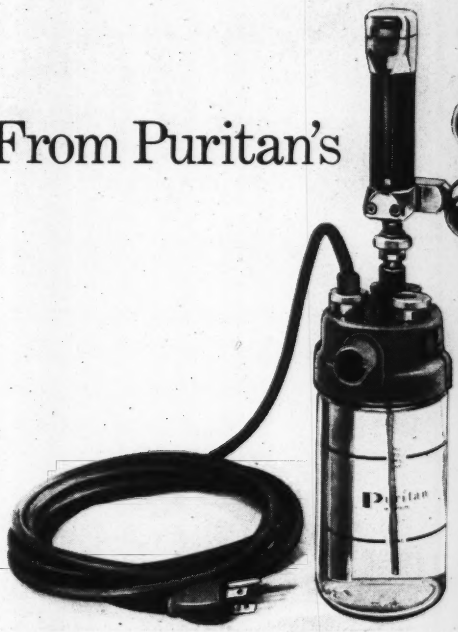

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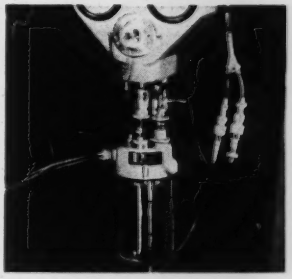

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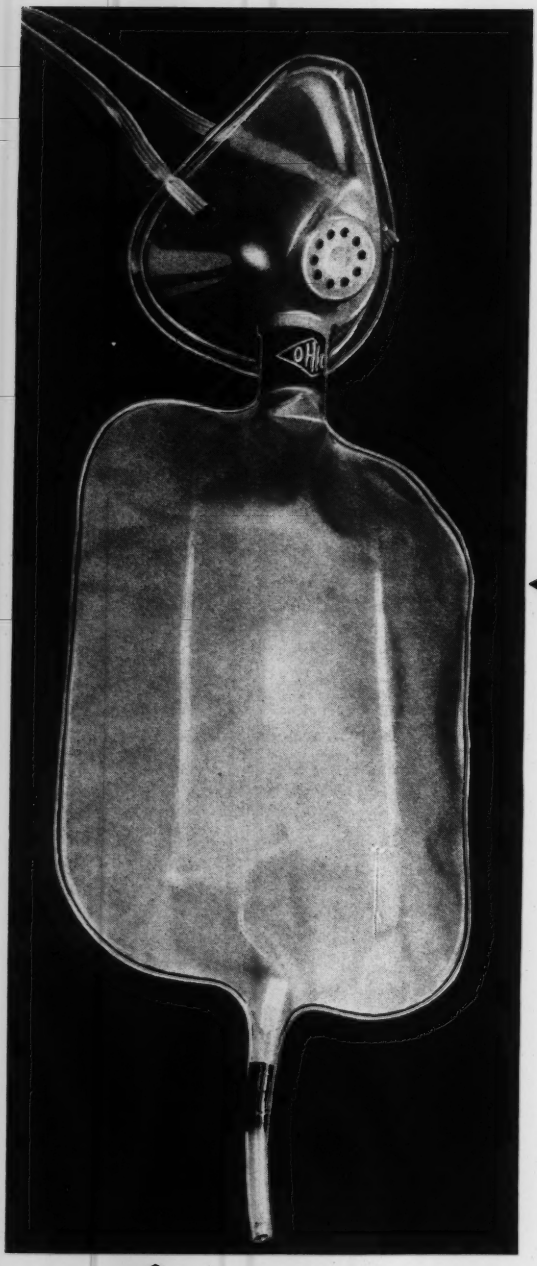

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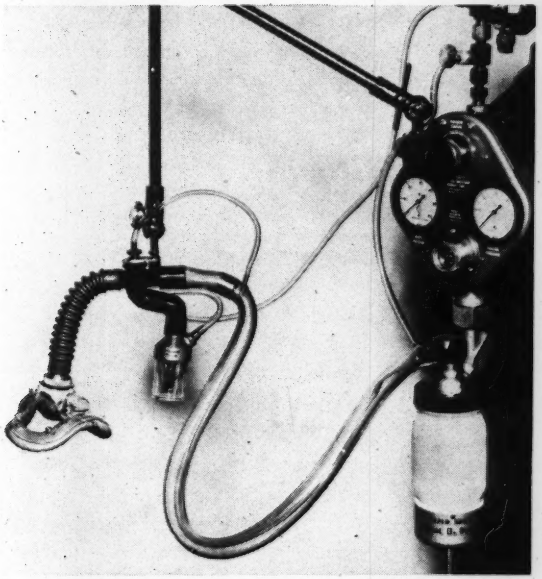

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Considerations in Humidification by Nebulization:
Ivan Cushing, MD, and William F. Miller, MD.
Diseases of the Chest, Oct. 1958, Vol. XXXIV, No. 4.

Pulmonary Emphysema:
Hurley L. Motley, MD.
Missouri Medicine, June 1960, pp 701-709.

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Editorial

Understanding the Asthmatic

THE IMPORTANCE of the relationship between the asthmatic patient and the inhalation therapist cannot be underestimated. This is especially true during times such as these when the field of inhalation therapy is expanding so rapidly. It is apt to be forgotten or regarded as inconsequential that the patient should be treated by assurance and with understanding.

By far the most important problem is in creating a sound relationship with the patient. In many instances the patient displays little understanding of his own in the face of illness. Therefore his true character is out of sorts and often gives way to apprehension, discontent, and irritability. Once this is understood by the therapist, the ground work has been laid for a suitable relationship.

It must be reiterated that the relationship between the patient and the therapist cannot be underestimated, for the result of the treatment the patient receives may depend to a great extent on the amount of interest shown him by the therapist. The essence of the relationship should be friendly, but by no means should the therapist become emotionally involved.

Relaxing the patient mentally is a significant step in preparing him to receive therapy, and this result is usually produced only deliberately and not by accident. Patients vary in character, intelligence and temperament; and it should be stressed that not all patients can be activated in the same

manner. Rather, they should be treated as individuals, according to these factors. The relationship should be carried on harmoniously and its creation should be accomplished unobtrusively. The patient's basic response to a well-established relationship results in his acceptance of treatment, his decrease in apprehension, and his confidence in the therapist. While these things are not always accomplished immediately, the determining factor may lie in the therapist's attitude.

The nature of the patient's illness in many instances may affect the attitude of the therapist. In a case of this nature the therapist would be wise in re-examining his personal feelings to determine how they are expressed in his attitude. The mature therapist realizes that all too many asthmatic patients are stigmatized unjustly: whether the physician has diagnosed the condition as based on physical or emotional factors, the patient is nevertheless ill, and should be regarded as such. Therefore, the therapist's attitude toward the patient and his illness should be therapeutic.

Every therapist should show a genuine interest in his patients, for it is through this interest that the very best results are achieved. It is essential for the therapist to understand fully the patient's feelings regarding his treatment. They may make the difference between a speedy or a slow recovery. If a patient feels like complaining, listen to him. The complaint may be justified, and if it is ignored, the patient may lose confidence in the therapist, destroying the rapport which has been established.

Some patients experience a tremendous amount of fear at the sight of therapy equipment. This is not an uncommon occurrence among asthmatics. To alleviate this tension and reduce fear to a minimum it may require a concentrated effort toward sympathy and understanding on the part of the therapist. He must keep in mind that his responsibility goes further than the application of equipment, and should work out a supportive plan to help the patient make the necessary adjustment. Extra time is required with this type of patient, so patience can be a valuable aid to the therapist.

Any person when hospitalized is out of his natural environment. Some adjust and accept conditions quickly, but many patients find the adjustment considerably more difficult. Here again the therapist can accomplish much by having an urbane attitude. Making the patient feel that he is in an understanding and interested environment lessens his anxiety, comforts him, and boosts his morale. A word of encouragement is always comforting, and the expression of confidence in the physician and the treatment on the part of the therapist adds to the confidence of the patient.

The quality of the therapist's work demonstrates his knowledge and ability, and everything he does reflects directly on his hospital. Therefore, he has an obligation to his hospital and to himself as well as to his patients. It is the therapist's duty to work with assurance and efficiency, in order to uphold the high standards of his hospital, his profession, and himself. It is to this end that he should strive.

—H. Eugene O'Conner
Chief Inhalation Therapist
Faulkner Hospital, Boston

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Sister M. Teresa is a Certified Registered Nurse Anesthetist at St. Elizabeth Hospital, Granite City, Illinois. She is a graduate of St. Louis University College of Nursing and Barnes Hospital School of Anesthesia in St. Louis; a member of the American Association of Nurse Anesthetists, and a Life Fellow of the Seminars on Hypnosis Foundation. She is also an Associate member of the AAIT.

Consider Not Only The Therapy, But The Patient As Well!

by Sister M. Teresa

UNCONTROLLED fear in a patient already dyspneic from physical causes can evoke a vicious circle of paralyzing emotions, rendering an otherwise cooperative patient intellectually helpless, or even injurious to himself:

FEAR - BODILY EFFECTS - REALIZATION OF FEAR - ANXIETY - FURTHER CONSIDERATION OF BODILY EFFECTS - MORE TREMULOUSNESS - MORE FEAR, etc.

Since inhalation therapy is often a life-saving treatment, the emergency nature of the procedure is potentially frightening to the patient, because people tend to fear the unknown. We can tolerate unpleasantness if we expect it, know it is inevitable, and anticipate beneficial results — especially if we know how to control our reaction somewhat. But not knowing what to expect engenders tension, fearful anticipation, and an inability to cooperate.

Many patients in need of inhalation therapy are apprehensive to say the very least. Whether this apprehensiveness increases or disappears depends largely on the therapist's WORDS, ACTIONS AND MANNER. The patient will listen to every word the therapist says, and will place his own interpretation on it, which makes the choice of words by the therapist most important. The patient will watch the therapist's every move, and will readily discern either self-assurance or timidity. The patient needs to know that the therapist is qualified, that he is really interested in the patient and nothing else for the time; and he also needs to know just how much more discomfort is to be anticipated.

As a rational being, the patient has a right to have his treatment explained briefly in terms meaningful to him, thereby enlisting his intelligent cooperation. Terms meaningful to an ill, anxious, and therefore self-centered patient include answers to "What's this going to feel like?", "What will it do to me?", and "What am I supposed to do?"

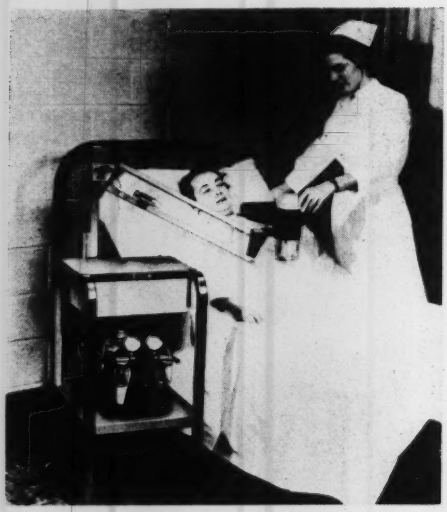
For instance, when placing a dyspneic, perspiring patient in an oxygen tent, one might include in the explanation something like, "You'll feel refreshed in this tent. Your breathing will be eased, and we'll adjust the temperature to suit your comfort. You'll be able to relax in an abundance of fresh oxygen . . . I'll stay with you till you're more comfortable, and we'll check you often to be certain that everything's all right. We'll keep your doctor informed of your condition."

A distressed patient will be greatly relieved to hear REFRESHED, EASED, COMFORT, RELAX, FRESH, I'LL STAY WITH YOU, CERTAIN, ALL RIGHT, YOUR DOCTOR—particularly if these comforting words are spoken by a

therapist who obviously knows what to do and who handles the patient gently.

When referring to an oxygen catheter, one can call it a smooth little tube "to carry the oxygen right where it will be picked up by every breath you take." This is soothing in contrast to "that horrible hose in my nose" that the patient may have heard about previously.

A patient about to receive intermittent positive pressure breathing treatment will be happy to hear that he can relax and let the therapist and the machine help him to breathe deeply, easily. "You can relax and let us work for you. You know, relaxing requires no energy output; and you



Time taken to explain the operation of equipment is repaid by a reassured, cooperative patient and more effective therapy.

— Photo courtesy of Air-Shields, Inc.

can't force relaxation, but then, you don't have to. Just *let* yourself loosen up. Make like a wet noodle and you can enjoy really easy breathing. Lots of oxygen will come through here and go all the way into your lungs. You will feel them being filled with this fresh air, which comes back out again all by itself. You don't have to do anything but lie here and be lazy. All you smell is the nice clean plastic, or this soft cushion (mask)."

The words RELAX, ENJOY, CLEAN, SOFT are welcome words, conveying the idea to the patient that the therapist is interested in the patient's welfare. Concomitantly giving undivided attention to the patient's needs is an effective therapy synergistic with the oxygen, since it inspires confidence and tranquillity.

Consider too the wretched feeling the patient develops when two therapists enter the room and it becomes apparent that one is a beginner, who is going to secure "experience" at the patient's expense. Would it not be better for all concerned if the "beginner" were not so labelled in the patient's opinion, and if the patient were not made to feel himself to be a practice object, subject to a beginner's mistakes? The teaching could be done before seeing the patient, and any further explanations could be worded as if the *patient* were receiving instructions.

Also, what patient would not be righteously indignant if upset by two people "working on" him (or on some equipment near him), and talking simultaneously to each other about last night's late-late, or "My 'horrorscope' says I should be careful today or I might hurt somebody." Even scientific discussions are objectionable if they exclude THIS PARTICULAR PATIENT'S IMMEDIATE INTERESTS. An acutely ill patient does not care if what the therapist is doing for him will be of benefit to future patients by accumulating data to prove or refute some theory. If the same patient were well, he might cooperate in research projects, but to a sick person, these are "experiments" using him as a "guinea pig." Because the patient is ill, he wants and *needs* tender, loving, effective care RIGHT NOW.

A hypoxic individual, typified by a drowning person who will grab for any straw offering the least hope of rescue, is overwhelmed by the urgency of his oxygen needs. Let us say he is self-hypnotized by his own fears. He will therefore respond instantly and literally to suggestion, which can be verbal or non-verbal, but must have a *POSITIVE* aspect.

Recalling the vicious circle mentioned previously, the therapist must first take advantage of the patient's unusual aware-

ness of his own inner feelings (of fear) and change these feelings immediately to those of relaxation and confidence. This is done by well-chosen words, sincerely spoken, by one whose sole interest at the time is THIS PATIENT.

Whatever conveys to the patient the idea, "I'm going to help you now," will elicit relaxation. The usefulness of positive thinking is something to believe in and act upon, but not to talk about. If a patient erroneously concludes that I say he will begin feeling better *only* by his thinking so, then no matter how short of breath he is, he will have enough breath to tell me where to go!! But using the positive approach as a basis, one can help the patient accept therapy in a relaxed frame of mind, with dividends in increased comfort.

If, in utilizing sympathomimetic amines, a tremulousness or passing discomfort is to be anticipated, this should be mentioned. Likewise, the effective action of the Cofflator should be explained as "packed with power"—to soften the surprise when the cough comes.

However, words connoting pain, tension, difficulty, choking, gasping, and feeling badly are definitely always to be avoided. Simple phrases like LOTS OF FRESH AIR FOR YOU, SOON FEELING MORE COMFORTABLE, BREATHING E-A-S-I-L-Y, have a tremendous therapeutic effect when properly combined with application of technical skills and the physician's other prescribed therapies.

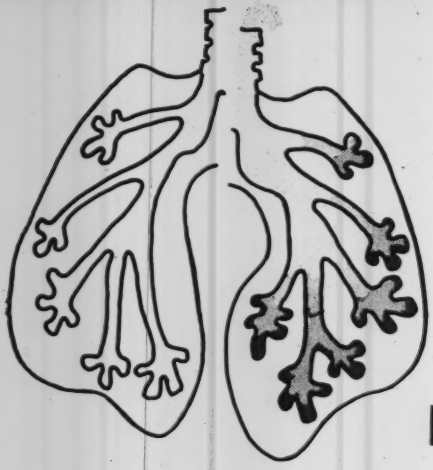
Restlessness, one of the manifestations of hypoxia, is relieved by oxygen; but it is relieved more quickly and effectively by oxygen plus kind words and gentle handling. This is true even if the patient is apparently unconscious. Anesthetized, sleeping, comatose, and semi-conscious patients may not consciously recall what they heard while apparently deaf to all sounds, *but they DO hear!* Though they may not be physically capable of reacting to it at the time, people hear *not* what is *meant*, but *exactly what is said*.

Alarm clocks are used universally on the premise that we hear when asleep—not saying we remember having heard, or that we respond to what we hear at the time. Another fact of which the therapist should be cognizant is that a drowsy and ill person is *humorless* and *unable to reason* clearly *or to act* energetically. Consequently, an "unconscious" patient, hearing attendants say, "He looks like Death warmed over," will not necessarily give any evidence of having heard; he will NOT take the remark as a joke, and will NOT know that it is being said about the passing interne who was up all night on maternity. This patient then begins to feel worse, and will show the effects symptomatically *later*.

It behooves the therapist to know the patient's general condition, as well as the pharmacology of all medications the patient is currently using, in order to understand various reactions, and to time his treatments to contribute to the patient's greatest comfort. Rapport and consultation with the medical and nursing personnel on the part of the inhalation therapist will result in optimum patient care, though it may mean sacrificing one's own time or prestige.

Speaking of time leads us to the discussion of the delightful challenge of therapy of children. The extra time spent in preparation will be amply repaid in smoother relationships and ultimately faster therapeutic results. Children detect the therapist's inner sentiments via the latter's WORDS, ACTIONS AND MANNER, even more readily than do adults. Little ones respond to game-playing and will accept the most grotesque equipment as *fun* if it is introduced properly: as an "outer space" gadget, or something his favorite comic character uses, or that the child will surely like.

Rules for successful therapy with children are: (1) Make friends first. (2) Play a short game, or just talk to discover his interests. (3) Do something simple and entertaining with him to help him into an accepting mood. *THEN* bring on the outer space helmet or Rube Goldberg contraption, and you and the other kid will have fun with it. Nine out of ten other kids anyway. . . .



Pulmonary Edema

Its Causes

Its Recognition

Its Treatment

by Robert D. Macmillan, M.D.

PULMONARY edema, especially in its acute form, is a profound disorder of cardiac and pulmonary function of grave significance to the patient suffering from it, and of grave concern to anyone who must care for such a patient. Its presence in the patient coming to surgery or its occurrence during anesthesia demands both accurate diganosis and prompt, appropriate and effective treatment. A thorough understanding of the basic physiology of the pulmonary circulation and the mechanisms of edema formation is essential to the prevention and treatment of this disorder.

Dr. Macmillan received his anesthesiology training at Duke University, and is now an anesthesiologist at Keesler Air Force Base in Biloxi, Mississippi.

I. Physiology of Pulmonary Circulation

It is important to realize at the outset that edema in the lungs develops by exactly the same processes as edema in any other tissue; the important differences are in the anatomic structure of the lungs and in the pressure relationships involved.

Simply stated, the function of the pulmonary circulation is to transfer blood from the right to the left ventricles of the heart through an area which allows indirect contact between the blood and alveolar air. It is this contact which permits oxygenation of venous blood, excretion of certain wastes, and absorption and excretion of inhaled anesthetic agents. A secondary function of the pulmonary circulation is to act as a reservoir for blood. Normally, the pulmonary artery carries venous blood through a series of ramifications to an infinite number of capillaries which surround the alveoli in an almost continuous sheet. Since only the thin alveolar membrane and the still thinner capillary endothelium separate the blood from the inhaled air, there is normally adequate opportunity for exchange back

and forth between the blood and air at this point. Various disease states, including pulmonary edema, may interfere with this exchange.

These pulmonary capillaries have some unique and important properties. They have a hugh surface area—estimated at around 150 square meters. They are widely distensible; they are capable of changing from a volume-flow of four liters per minute at rest to one of thirty liters per minute during hard work in a matter of only a few seconds. They freely anastomose (connect) with capillaries of the systemic circulation, yet there appears to be little cross-circulation between them. The endothelium of the pulmonary capillaries is dependent upon the alveolar air for its oxygen supply; thus, anything which interferes with alveolar ventilation will also cause damage to the endothelium from hypoxia.

The lymphatics in the lungs start at the alveolar ducts and join to empty eventually into the thoracic duct. They normally serve to remove the small amount of protein-rich fluid that slowly transudes into the alveoli. The flow of lymph in these vessels is passive—depending to a great extent on the movements of the lungs during breathing.

The pressure within the pulmonary circulation is normally considerably lower than that of the systemic circulation. It is a low pressure system capable of large volume changes, as contrasted with the greater circulation, which is a high pressure system with a much more limited ability to compensate for volume changes. Normally the pressure in the right ventricle during systole is 25 mm Hg., the pulmonary artery pressure is about 25/8, and the pressure in the pulmonary capillaries is only 5 to 10 mm Hg. The pulmonary circulation time is about eleven seconds. The total blood in the pulmonary circulation is 400 to 600 ml., or about 8 to 10% of the total blood volume.

In tissues other than the lungs (the skin, for example), the outward force of the 25 to 30 mm Hg. blood pressure in the capillaries is opposed by the protein colloidal osmotic pressure of 25 to 30 mm Hg. and also by the tissue pressure, which is hard to measure by itself. Thus, any transudation is very slow and small in amount. In the lung, the protein colloidal osmotic pressure is the same as in the skin, but the capillary blood pressure is much lower—on the order of 5 to 10 mm Hg. The pulmonary tissue pressure is almost negligible. So, under normal circumstances, there is very little tendency for transudation of fluid out of the pulmonary capillaries. The small amount of fluid which escapes is rapidly reabsorbed by the lymphatic vessels. *Pulmonary edema results when the lymphatics of the lung are unable to resorb fluid as fast as it is being formed.*

Many factors may cause or contribute to the formation of pulmonary edema. All except perhaps one can be classified as being primarily due to one of the following mechanisms:

A. Decreased osmotic pressure of blood proteins.

This is the least common and the least important mechanism. It is significant only in patients with far advanced cirrhosis of the liver, or in chronic glomerulonephritis.

B. Increased pressure in the pulmonary capillaries.

This is the usual mechanism by which primary cardiac disease gives rise to pul-

Editor's Note: We would like to remind the many therapists to whom it may seem inappropriate to allude to medical treatment which they are in no position to give, that the Journal is also read by many practicing anesthesiologists and nurse anesthetists, for whom these remarks are quite appropriate.

Further, it is your Editor's opinion that the good therapist should have at least an acquaintance with the medical treatment which his patient is receiving. Often it helps much in understanding why the doctor orders the modalities that he does, and makes the therapist better able to converse intelligently with him about the patients and their therapy.

monary edema. If there is a disproportionate inability of the left ventricle as compared to the right to respond to an augmented inflow load, then an increase in pulmonary congestion results. Actually, pulmonary edema is usually associated with an increased cardiac output, but the left ventricle increases less than the right. When the left ventricle thus *relatively* fails, the pulmonary capillary pressure rises and transudation of fluid can occur. This pressure must reach 25 to 35 mm Hg. before frank edema results. Anything that causes an increase in breathing (for example, sudden exercise, a paroxysm of coughing, fever, respiratory infection) augments the inflow to the right heart. In a patient with predominantly left heart dysfunction, pulmonary edema may result. This type of heart disease is seen most commonly in patients with such valvular abnormalities as mitral stenosis and aortic insufficiency, and in hypertensive cardiovascular disease. Sudden severe peripheral vasoconstriction such as from an overdose of vasopressor drug may produce sufficient left ventricular strain and inadequate output as to result in pulmonary edema.

The pressure and the volume of flow through the pulmonary capillaries are significantly affected by changes in position. The most common manifestation of these changes is the orthopnea seen in patients with disorders which strain the left heart. In changing from the upright to the supine position, there is a shift in blood from the legs and abdomen into the lungs by gravity, to the extent that the volume of blood in the lungs may be doubled. The cardiac output may have to increase from 5 to 25% to compensate for the increased venous return. In the supine position, the weight of the abdominal viscera limits the descent of the diaphragm. This effect, when combined with the increased pulmonary blood volume, will decrease the vital capacity 5 to 10% in normal persons, and 10 to 30% in patients with heart disease. These effects are exaggerated by the Trendelenburg position.

Another mechanism by which the pulmonary capillary pressure may be pathologically elevated is by the *excessive infusion of intravenous fluids.* This is especially true when these fluids are in the form of colloidal material, such as whole blood. This factor is much more important in children, who obviously have a smaller total blood volume than adults, and in cardiac patients, who tolerate very poorly even small changes in blood volume. It has been found that non-electrolyte fluids can be infused into cardiac patients at a rate up to 10 ml. a minute without danger, provided their renal function is adequate. Since renal function is depressed by most anesthetic agents, it would seem wise to stay well below this figure during anesthesia for persons with cardiac disease.

C. Increased pulmonary capillary permeability.

This is probably the most important single factor in pulmonary edema, especially that occurring under anesthesia.

Since the pulmonary capillary endothelium is dependent on alveolar oxygen for its maintenance, it is very sensitive to hypoxia. Hypoxia increases capillary permeability and allows increased filtration of fluid into the alveoli. Hypoxia may also result secondarily from other factors which also influence capillary permeability. In addition, anoxia dilates the pulmonary arterioles and constricts veins and venules in order to allow both more time and more blood flow to the hypoxic areas. The effect, however, is to increase the vascular congestion in the area and the transudation of fluid out of the damaged vessels. In bronchoconstriction, generalized vasoconstriction results, thus initiating a cycle of hypoxia and further capillary damage. There is some indirect evidence that brochospasm may be a factor in primarily cardiac pulmonary edema.

Excessive inspiratory effort against unusual resistance or obstruction may also damage the pulmonary capillaries, permitting leakage of fluid. Common examples in anesthesia are laryngospasm, obstruction of endotracheal tubes, and excessive resistance in the anesthetic machine. This last factor is especially im-

portant in children. The lung capillaries are poorly supported and unable to retain their contents against a markedly increased negative intrapulmonary pressure, which actually exerts a sucking action on the capillary walls.

Another common means by which the pulmonary capillary permeability is increased is by direct irritation from such things as the aspiration of gastric juice, aspiration of liquid anesthetic agents, or inhalation of irritating gases. The potency of the agent as an irritant and its solubility in water determines what parts of the respiratory tract will be affected, and when the effects will be manifested. For example, ammonia, formaldehyde and chlorine gas are extremely irritating and their effects will be immediate and mostly on the upper respiratory tract; nitrous fumes (blasting powder) and burning celluloid are less toxic, and their effects will be delayed several hours and involve the lower respiratory tract; phosgene, nitrogen dioxide and sulfur dioxide are delayed still longer. In patients with known exposure to these latter agents, it is important to keep them under observation for several days, because of the possibility of delayed development of pulmonary edema. Some of the contaminants of anesthetic agents are potentially dangerous in this regard: Chloroform is oxidized in the presence of flame to phosgene, which is extremely irritating to the alveoli; nitric oxide (an impurity in nitrous oxide) combines with the water in the alveoli to form nitric acid; the ether peroxides which form on exposure of ethyl ether to air may cause capillary irritation.

Several other unusual situations which may result in increased pulmonary capillary permeability should be mentioned for the purpose of completeness. Certain drugs, especially the thiourea compounds and methyl salicylate (oil of wintergreen) apparently have a selective and specific toxicity for the pulmonary capillaries, with a resultant pulmonary edema which does not respond to the usual therapeutic measures. Some respiratory allergies are manifested by the transudation of fluid into the alveoli through sensitized and damaged capillaries. These capillaries may also be injured by the metabolic wastes retained in terminal uremia.

It has been known for a long time that acute pulmonary edema may follow severe brain injuries, cerebral vascular accidents, or encephalitis. The mechanism for this condition is unknown, but it is thought to be through increased capillary permeability. It has been demonstrated that this can be prevented or annulled by blocking the vagus nerves. Emotional factors are known to play a significant role in the repeated bouts of pulmonary edema seen in patients with long-standing cardiac disease.

II. Diagnosis of Pulmonary Edema

It is important to realize that many different degrees of pulmonary edema are possible, from a low grade, chronic state with few symptoms or signs, to the fulminating acute type with all the classical clinical findings.

In the conscious patient with full-blown acute pulmonary edema, the physical findings will be centered on the cardiorespiratory systems. The patient will be dyspneic and orthopneic; the respirations will be rapid and shallow and have a definite wheezing character. Generalized rales will be heard throughout the lung fields, especially in the dependent portions. Copious amounts of frothy pink sputum will be coughed up or may be aspirated from the tracheobronchial tree. There will be cyanosis due to mechanical interference to air flow by the fluid present in the alveoli. These patients are usually quite apprehensive – most likely the result of their hypoxia. The pulse is usually rapid and weak, and the blood pressure may be low. An X-ray of the chest at this time would show a patchy, usually symmetrical opacification of the lung fields, especially in the lower lobes, and obscuring of the normal parenchymal blood vessel markings.

The diagnosis in the anesthetized patient may be considerably more difficult to make. It must be carefully differentiated from other cardiovascular or respira-

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Gas Sterilizers Pay For Themselves!

by Walter D. Moore*

THERE can be little doubt in the mind of any professional personnel associated with hospitals concerning the need for sterilization, whether it be steam or gas type, when one considers the problem of cross-infection that many hospitals are facing today.

The difficulty arises, however, when the conventional steam sterilization process proves damaging to heat-sensitive materials, or does not thoroughly sterilize such items as anesthesia apparatus, heart-lung oxygenators, or other similarly complicated equipment. There is, therefore, a very definite need for a supplementary means of sterilizing this equipment which is not satisfactorily processed with steam. This supplementary method of sterilization has proven to be gas sterilization, using Steroxide gas, which has *ethylene oxide* gas as its lethal component.

Ethylene oxide has excellent properties for use as a sterilant, and it may be used at temperatures as low as room temperature. The time element enters the picture here, though; and it is therefore recommended that the gas sterilizer be used at temperatures between 100 and 160 degrees Fahrenheit. Within this range, it requires from 2 to 8 hours to sterilize an object. A good rule of thumb to follow for estimating sterilizing time is to double the time for each 30 degrees decrease in temperature from 160°. Hence, at 160°, the time is 2 hours; at 130°, 4 hours; and so forth. At these temperatures there is little effect on most materials, with the exception of a few plastics.

At first glance, one might assume that the sterilizing is somewhat lengthy, as compared to the time required for steam sterilization; but the point here is that we are not attempting to replace steam sterilization, we are only supplementing it with gas sterilization.

We *are*, however, replacing *chemical* disinfection of an item, which requires

*Sales Engineer, the Wilmot Castle Company, Rochester, N.Y.

much more time than 2 to 8 hours if the object is to be completely sterile. So in making any time comparisons with gas sterilization, chemical disinfecting time should be considered rather than time for steam sterilization.

The relative cost of gas sterilization is only significant insofar as the savings a hospital may accrue from its use. The cost per cycle for gas sterilization is higher than that of steam, and the initial cost of the equipment is higher than that of steam equipment; but the savings come about through the fact that replacement costs of expensive equipment are significantly reduced. Many of those articles previously sterilized by steam were damaged by the heat and had to be replaced after not very many sterilizations; whereas with gas sterilization, the life of the article is increased, thus reducing replacement costs.

A case in point is rubber goods, or more specifically, surgical rubber gloves that were processed in our plant in Rochester, New York for a local hospital. Under these controlled conditions, we were able to measure the actual saving to the hospital over a one-year period. We discovered that the glove replacement cost was reduced from $7000 to $2800. With this type of saving, it is clear that the higher initial cost of a gas sterilizer is more than compensated for by the saving obtained from its use.

Consequently, in our opinion, there is a definite place for gas sterilization in a hospital, and there is also a dire need for it in many hospitals to combat cross-infection. The time required for sterilization is longer than for autoclaving, but considerably shorter than that required for complete sterilization by chemical methods. Lastly, the savings effected more than offset initial high cost. Consider these facts the next time you are faced with the problem of sterilizing anesthesia apparatus, heart-lung oxygenators, or any other heat-sensitive materials.

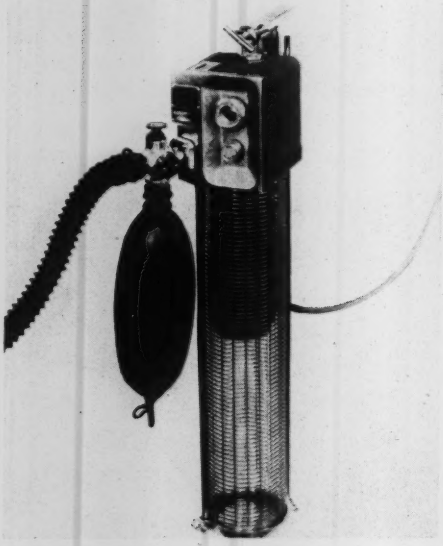
Gas Sterilizer at Children's Hospital, Milwaukee, Wisconsin.

EQUIPMENT NEWS

(Information and photographs are supplied by the manufacturers or distributors.)

Anesthalung

National Cylinder Gas Co. (Division of Chemetron, Inc.) announces an improved mechanism for use in surgery to aid the anesthesiologist in controlling rate and volume of a patient's breathing. Made for NCG by the J. J. Monaghan Co. of Denver, the Anesthalung incorporates a pressure-sensitive volume control of



extreme low resistance, and controls respiration by use of a bellows which operates in an airtight clear plastic chamber. Volume is determined by the anesthesiologist and controlled by a limitation on the expansion of the bellows, which is set by a simple control knob.

There is also ready control over the rate and pressure of gas supplied to the patient's lungs. The unit does not interfere with the patient's effort to breathe spontaneously, and he can override the system at any time. If he does *not* breathe according to a pre-set cycle, or if he is breathing too shallowly, the Anesthalung will take over and deliver the rate and volume preset by the anesthesiologist.

No. 530

Plastic Nebulizer

Hudson Oxygen Therapy Sales Co., Los Angeles, announces a new plastic nebulizer that is available in several models. The one illustrated here was designed especially for IPPB machines.

It is of unique new design which creates the following advantages: it produces a fine mist, does not spill when tipped, and keeps nebulizing when tilted at any angle. It does not clog easily, is easy to clean, and withstands rough usage.

In addition to the above IPPB nebulizer, all models of the standard Pen-i-sol line will henceforth be available in either Pyrex glass or plastic.

No. 531

AerOxy—Gen Oxygen Generator

Aerojet-General Corporation, a Subsidiary of the General Tire & Rubber Co., Azusa, California, now has in production the AerOxy-Gen oxygen generator, a simple device based on a new concept for the separation of oxygen directly from the atmosphere. It produces oxygen of purity up to 90%, the impurities being approximately 4% Argon and 6% Nitrogen.

The initial model illustrated here, weighing 150 pounds and occupying a volume of 6 cubic feet, will deliver 10 liters of gas per minute, or more than 500 cubic feet per day, at a pressure of 35 psig.

The lifetime of the unit is indefinite, since it is completely self-contained, except for power, and is self-regenerating.

No. 532

Portable Air Compressor

Announcement has been made of a complete line of portable, oil-free, piston-type air compressors by the Winslow Manufacturing Corporation, Hialeah, Florida.

The design of these pumps insures maintenance-free operation by eliminating lubrication and diaphragms that rupture. The cylinder liner is of stainless steel; the non-lubricated piston includes a specially compounded Teflon cup backed with a silicone O-ring. They have an automatic safety pressure release which is adjustable to release pressure in excess of preselected amount up to 100 psig.

No. 534

Their weight is only 18 pounds, length 10". They are available with pressure gauges and other accessories if desired.

Duplex Economy Manifold

Ohio Chemical & Surgical Equipment Co. (a Division of Air Reduction, Inc.) has developed a new Duplex Economy Manifold for oxygen or Nitrous oxide, specifically designed to meet the needs of the small user. The unit meets all the requirements of the NFPA Code set forth in Phamphlet No. 565.

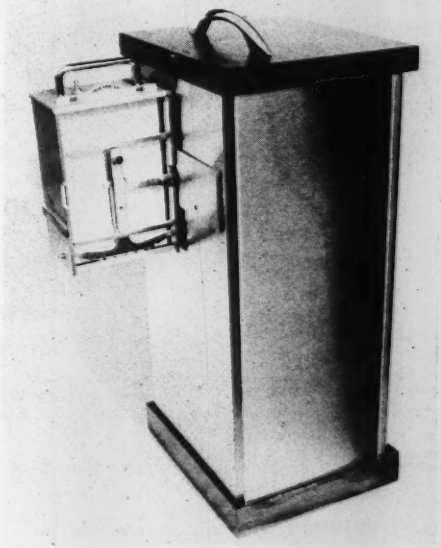
The manifold includes practically all of the features normally found in more expensive cabinet type units. It is complete with automatic switchover, line pressure regulators and header valves, check and safety valves plus cylinder coils.

It is easily assembled and adjusted, requiring slightly more floor space than necessary to accommodate the cylinders.

No. 535

Pulmonor

The Jones Metabolism Equipment Company of Chicago has begun production of a new pulmonary function testing unit called the Pulmonor,



which has been specifically designed to provide the complete range of high velocity and volume tests that are being required today. This waterless instrument has been reviewed by foremost lung function specialists and promises to compare very favorably with present water type equipment.

This low-inertia system offers portability, inkless graphs, double sensitivity setting, variable volume shift and reversible timer, which give a wide flexibility of range to meet nearly every requirement.

No. 536

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continued from page 19
tory complications which may also arise under anesthesia. In the anesthetized patient with acute pulmonary edema, the pulse is usually weak and rapid, but it may be slow and weak, especially in older patients. The pulse pressure will be narrow and the systolic pressure low. This hypotension does not respond to either generous doses of vasopressors or blood replacement—in fact, these measures may well make the situation worse. The venous pressure will be elevated, usually above 150 cm. of water. This is the only form of hypotension in which the venous pressure is high. and this fact represents an important differential diagnostic point.

Usually there will be signs of peripheral stasis; poor capillary refill, cyanosis of the nail beds, ear lobes, forehead, and face. Rales may be heard throughout the chest, and frothy sputum in large quantities may be aspirated from the lungs. There will be difficulty in ventilating the patient, even with an endotracheal tube in place.

III. Treatment of Pulmonary Edema

The vigor of treatment of pulmonary edema and the doses of the various medications recommended will depend on the severity of the attack or the urgency of the situation in which the attack occurs. The direction or emphasis of the treatment will depend somewhat on the underlying cause of the attack. Basically, however, the various forms of treatment are aimed at the correction of the abnormalities which have been listed above.

For the conscious patient, Fowler's position will provide the most comfort. Conditions during surgery may not permit such a radical change in position—in this case, slight reverse Trendelenburg should be used. If profound shock is present, it will be necessary to place the patient in conventional Trendelenburg position.

A clear and controllable airway should be established. In the anesthetized or semi-comatose patient, endotracheal intubation is a rapid and efficient means. In the conscious patient with marked respiratory difficulty, a tracheostomy is indicated. Both of these methods allow continuous control of the airway, decrease the dead space, permit more effective removal of the excessive secretions, and provide a means for positive pressure respiration. Since large amounts of foamy sputum are a prominent feature of this disorder, these patients should be suctioned frequently, but rapidly. The use of anti-foaming drugs may be of benefit.

For the acute attack, oxygen under continuous positive pressure of 10 to 15 cm. of water should be provided. The positive pressure supplies a counterpressure on the lung capillaries and rapidly reduces the transudation from them. It serves to reduce the venous return to the right heart and also improves the flow of lymph by the massaging action of the moving lungs. In addition, it relieves the cyanosis usually present, and helps combat the hypoxic damage to the capillary endothelium. Other methods of reducing the venous return and the pulmonary blood flow are the application of tourniquets alternately to three of the four extremities for 15 to 20 minutes at a time, or actual venesection, with removal of up to 500 ml. of blood.

If bronchospasm appears to be a significant factor, it may be relieved by the cautious administration of up to 500 mg. of aminophylline intravenously. It may also be helpful in this situation to dilute the oxygen being administered with 50% Helium.

If the patient is conscious and very apprehensive, small doses of short-acting sedatives may be considered. Narcotics or other drugs that depress respiration should not be used. In most cases, it will be found that the apprehension will subside as soon as adequate oxygenation is established. Mercurial diuretics may aid in mobilizing the edema fluid. Of course, any intravenous fluids or medications given during the acute attack should not contain sodium.

Rapid digitalization should be considered if the attack of acute pulmonary edema is thought to be primarily due to a cardiovascular mechanism, or if it occurs from some other mechanism in a patient with pre-existing cardiac disease. The agents most commonly recommended for

continued on page 26

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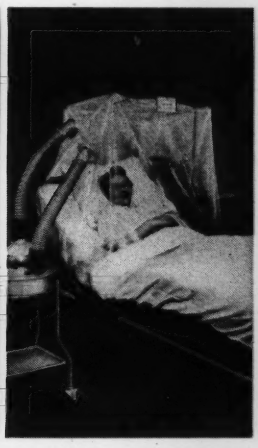

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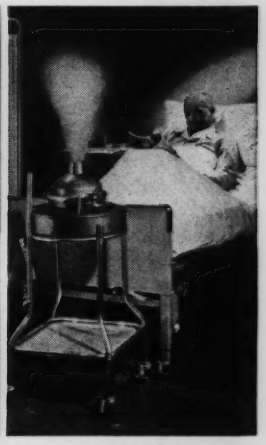

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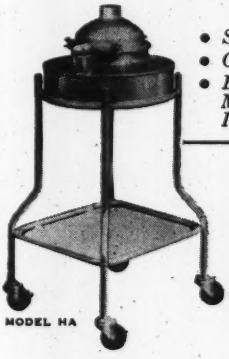

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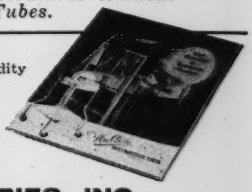

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this purpose are lanatoside C (cedilanid) and digoxin (lanoxin). These preparations are about equal in onset of action, digoxin being slightly more rapid in onset and somewhat in duration of action. One-half to three-fourths of the digitalizing dose may be given intravenously over a period of several minutes, depending on the urgency of the situation. The remainder may be given in one hour if the occasion demands it. Beneficial effect can be expected in 5 to 10 minutes, but may be delayed for 30 minutes to one hour. If there is some doubt in an individual case as to whether digitalization is indicated, it is probably better to do it, since digitalis preparations are fairly innocuous to the normal heart.

The gastro-intestinal symptoms of anorexia, nausea and vomiting may give warning that the toxic dose of digitalis has been reached in the conscious patient. However, with the more purified digitalis preparations (as digoxin and lanatoside C are) and in the anesthetized patient, disturbances of cardiac rhythm may be the only indication that toxicity has occurred. The most common arrhythmias attributable to digitalis intoxication are bradycardia, premature beats, bigeminy, and occasionally a nodal rhythm that may progress to a ventricular tachycardia. For this reason, the cardiac rate and rhythm should be monitored with an electrocardiograph whenever rapid digitalization is undertaken in the anesthetized patient. The usual electrocardiographic signs of digitalis effect are inversion of the T waves and prolongation of the P-R interval. It has been suggested that the rhythm disturbances due to digitalis intoxication may be alleviated by giving small amounts of potassium chloride very slowly and cautiously intravenously.

In cases of pulmonary edema that prove resistant to the above listed forms of treatment, one other method of diminishing venous return and relieving the load on the heart has been suggested. The maintenance of continuous spinal or epidural anesthesia at a fairly low dermatome level may result in sufficient dependent pooling of blood to lower the venous pressure and permit other therapeutic measures to take effect.

In conclusion, two special surgical problems which may predispose the anesthetized patient to pulmonary edema should be mentioned. During pneumonectomy, the volume of the pulmonary circulation is suddenly drastically reduced; and during occlusion of the aorta in vascular surgery, the volume of the vascular bed is temporarily markedly reduced. In both these situations, blood and other intravenous fluids must be given very slowly and carefully, to avoid overloading the functioning circulation.

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Heated Hypertonic Aerosol in Collecting Sputum Specimens for Cytological Diagnosis:
David M. Berkson, MD; Gordon L. Snider, MD. JAMA, Vol. 173, No. 2, pp 135-138.

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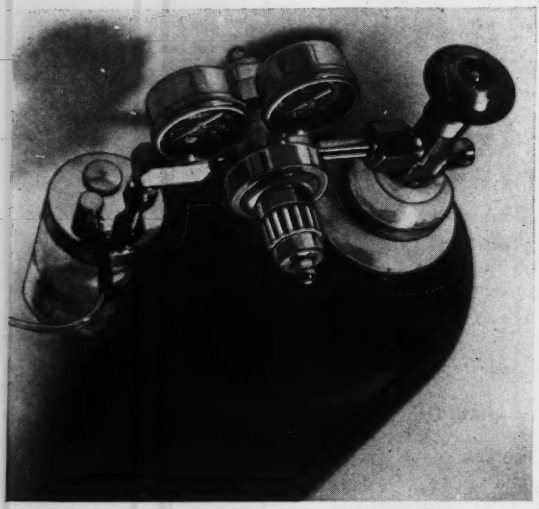

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CHAPTER ACTIVITIES

by Howard R. Dockham

At their October meeting, the **Rocky Mountain** chapter discussed the idea of having the Chapter pay the registration fee for the President, other officer, or a member of the chapter to the national convention. At the same meeting, Mr. W. W. Lindsay of the Denver Fire Department talked about safety procedures in Denver hospitals. He invited a committee to meet with him in the future to formulate a set of regulations inhalation therapists would like to see followed in the field.

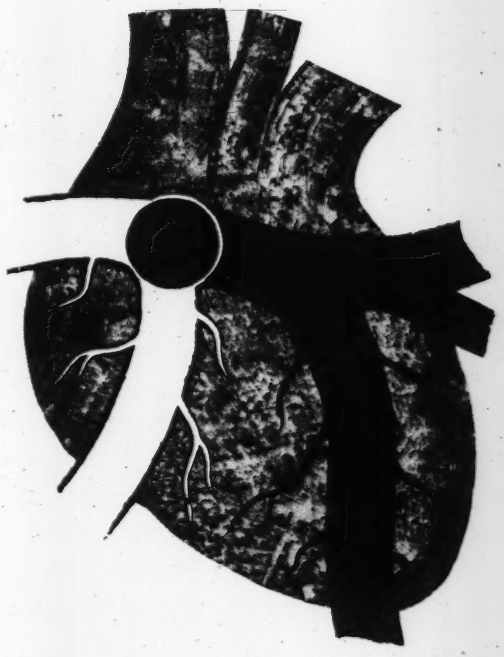
Dr. Norman E. Wilson of the Overholt Clinic of Boston, told the member of the **Greater Boston** chapter in May that "heavy smokers are all candidates for inhalation therapy post-operatively." In a question and answer period, Dr. Wilson also stated that patients with emphysema should not have high concentrations of oxygen, especially those with carbon dioxide retention. Speaking of IPPB, Dr. Wilson said that "a patient should have as much pressure as he can take with ease. To go one point further would be too much." In September, the members toured the National Cylinder Gas plant in Malden, Mass.

Mrs. Grace Farley, R.N., spoke on Positive Pressure and Resuscitation at an Institute held at All Saints Episcopal Hospital in Fort Worth.

In the August edition of *The Flowmeter* published by the **Upper Midwest** chapter, Dr. Philip H. Saucheroy of St. Paul, Minnesota discussed the paper

(Continued on Page 32)

One of the Sessions at the Baylor meeting.



"The use of oxygen in myocardial infarction is no longer a desperate or heroic measure. The principle of rest for the heart would require that oxygen be used for the patient who is cyanotic, dyspneic, in shock, in pulmonary congestion or edema, or suffering from a cardiac arhythmia with rapid heart action. Persisting pain of myocardial infarction may be relieved or reduced by oxygen therapy. In other cases, use of oxygen may well be justified for the first day or two in an attempt to prevent gross anoxia and to compensate for less overt degrees of oxygen deficiency."

—*Early Management of Myocardial Infarction:* B. E. Pollock; Journal of the American Medical Association, 161:404 (June) 1956.

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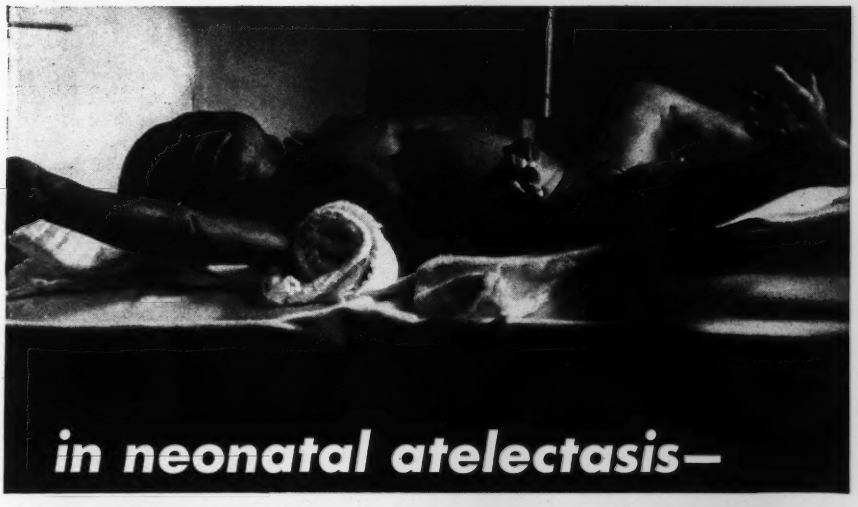
"Common Errors in Inhalation Therapy" by Vincent D. Kracum of the Ohio Chemical & Surgical Equipment Co.

Owing to difficulties both in receiving information promptly and then, unfortunately (chiefly because of pre- and post-convention story priorities), in finding space to print them, the following scenes are quite late in appearing. They are from events held in Texas last year, and are a good representation of chapter institutes held in other places too.

Dr. John Wiggins, Fort Worth physician, spoke on Anatomy & Physiology at the All Saints Institute, last April.



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1. Smessaert, Andre; Collins, V. J., and Kracum, V. D.: *New York J. Med.* 55:1587, June 1, 1955.
2. Banyai, A. L.: *Geriatrics* 14:621, Oct., 1959.

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Alevaire, trademark reg. U.S. Pat. Off.

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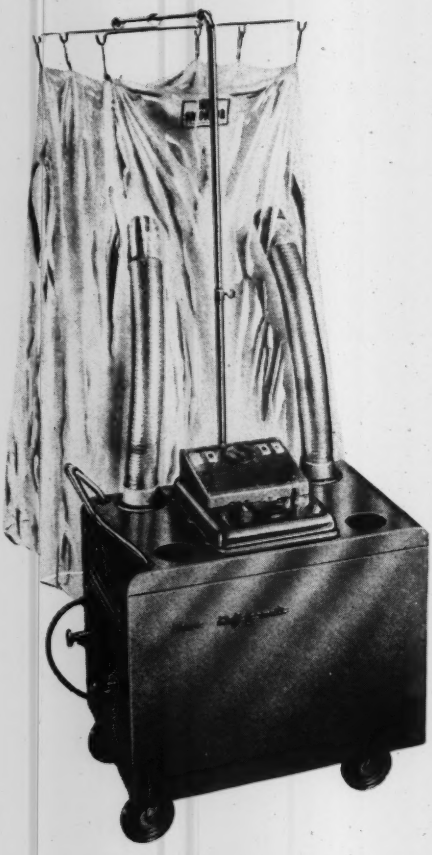

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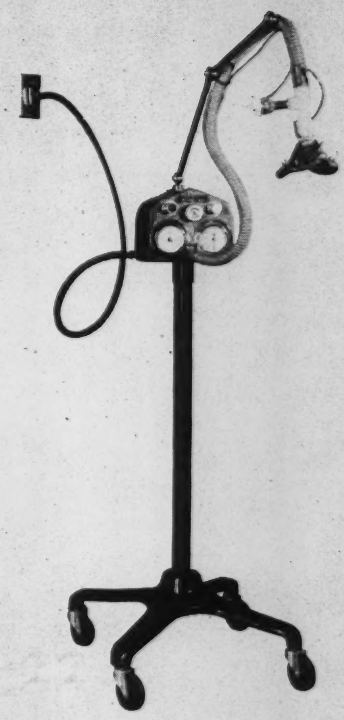
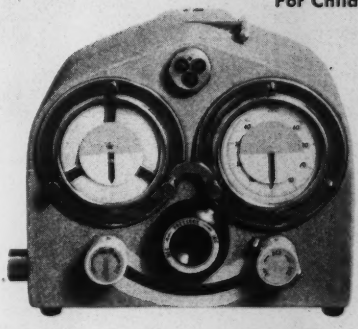


For Children



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